REMARKS

Claims 1, 3, 4, 6, 17, 19 and 20 are pending. Claims 1, 3, 4, 6, 17, 19 and 20 are amended. Claims 21-23 are new. Claims 1, 3, 4, 6, 17, and 19-23 now are pending.

I. 37 CFR 1.83(a): DRAWINGS

The Examiner objected to the drawings and requested that the Figures make reference to a third vertical type bipolar transistor in addition to the first transistor 101 (Figure 5) and the second transistor 102 (Figure 5).

The third vertical type bipolar transistor language is supported in the original specification at page 10, line 14, page 11, lines 5-6, and 9-10, page 14, lines 12-13, page 15, lines 3-5, page 15, line 25 though page 16, line 1, page 62, lines 16-17, and page 63, lines 24-25.

In the November 17, 2000 Office Action at page 8, item 11, the Examiner states that "Figure 5 depicts one embodiment, whereas figures 11 and 12J depict different embodiments. Applicant cannot take elements from one embodiment and combine them with elements of another embodiment in order to form a new device."

Applicant does not understand the above statement in the Office Action. Applicant is entitled to claim any features taught or suggested in the disclosure. Since, Applicant's specification specifically teaches a third vertical type bipolar transistor in the context of a first and second vertical type bipolar transistor, a device with a first, second, and third transistor is within the disclosure.

Since Applicant has broaden claim 17 by deleting the language "a third vertical type bipolar transistor" from claim

17, Applicant respectfully requests that the Examiner withdraw the objection to the drawings.

II. 35 USC 112(1): CLAIMS 1, 3, 4, 6, 17, 19 and 20

The Examiner rejects claims 1, 3, 4, 6, 17, 19 and 20 under 35 USC 112, first paragraph as reciting subject matter that is not supported by the original specification.

Since Applicant has fixed the reciting subject matter noted in the Office Action as indicated above, Applicant respectfully requests that the Examiner withdraw the rejection to the claims.

III. 35 USC 112(2): CLAIMS 1, 3, 4, 6, 17, 19 and 20

The Examiner rejects claims 1, 3, 4, 6, 17, 19 and 20 under 35 USC 112, second paragraph as being indefinite, specifically noting indefinite deficiencies.

Since Applicant has fixed the deficiencies noted in the Office Action as indicated above, Applicant respectfully requests that the Examiner withdraw the rejection to the claims.

IV. 35 USC 103(a)

A. CLAIMS 1, 3, 4, 6, 19 and 20

The Examiner rejected claims 1, 3, 4, 6, 19 and 20 under 35 USC 103(a) as unpatentable over Kumamaru (U.S. 4,379,726) or Watanabe (U.S. 4,258,379) in view of inherent structures.

Applicant disagrees that the combination of Kumamaru or Watanabe and inherent structures teaches each of the limitations of the claims.

As amended, **claim 1** now reads:

1. (Amended Five Times) A semiconductor device, comprising:
a substrate defining a datum surface;
an epitaxial layer formed on the substrate above the datum surface and having an epitaxial impurity concentration and an epitaxial conductive type;
a first embedded diffusion layer formed as part of a first vertical type bipolar transistor in a first upper part of the substrate;
a second embedded diffusion layer formed as part of a second vertical type bipolar transistor in a second upper part of the substrate,
wherein the second embedded diffusion layer includes an impurity concentration that is less than the impurity concentration of the first embedded diffusion layer, and
wherein a peak position of an impurity concentration of the first embedded diffusion layer resides at a first distance from the datum surface of the substrate and a peak position of an impurity concentration of the second embedded diffusion layer resides at a second distance from the datum surface of the substrate such that the first distance is greater than the second distance.

Claim 1 recites the limitation:

a first embedded diffusion layer formed as part of a first vertical type bipolar transistor

The Examiner presents Watanabe element 21 of Figure 8 as teaching the first embedded diffusion layer formed as part of a first vertical type bipolar transistor. However, the Examiner uses Watanabe element 21 for the 103 obvious rejection as taught in Figure 9 of Watanabe. (November 17, 2000 Office Action, page 6, lines 3-4). Figure 9 of Watanabe only relates to second vertical type bipolar transistor 201. In other words, the Examiner presents Watanabe element 21 of second vertical type bipolar transistor 201 in Figure 8 (e.g. Watanabe element 21(201) as teaching the first embedded diffusion layer formed as part of a first vertical type bipolar transistor. Since Watanabe element 21(201) does not teach a first embedded diffusion layer formed as part of a first vertical type bipolar transistor, Watanabe does not teach the above limitation.

Claim 1 recites the limitation:

wherein a peak position of an impurity concentration of the first embedded diffusion layer resides at a first distance from the datum surface of the substrate and a peak position of an impurity concentration of the second embedded diffusion layer resides at a second distance from the datum surface of the substrate such that the first distance is greater than the second distance.

a. Kumamaru

The Examiner presents Kumamaru element 14 as teaching the first embedded diffusion layer and presents Kumamaru element 5a as teaching the second embedded diffusion layer. There is nothing in Kumamaru that discusses such a teaching. Kumamaru does not teach the above limitation.

b. Watanabe

The Examiner presents Watanabe element 21 (201) of Figure 8 as teaching the first embedded diffusion layer of the first vertical type bipolar transistor 101. Moreover, the Examiner presents Watanabe element 22" of Figure 8 as teaching the second embedded diffusion layer of the second vertical type bipolar transistor 201.

The Examiner states in the November 17, 2000 Office Action at page 9 item 13 that:

> Watanabe teaches in Figure 8 a second embedded diffusion layer 22" being thinner and deeper than the first embedded diffusion layer 21 (101). Therefore, it is clear that the peak position of an impurity concentration of a region formed between the silicon substrate and a based region of the second vertical transistor is deeper than that of a region formed between the silicon substrate and a base region of the first vertical transistor.

Applicant agrees that Watanabe teaches in Figure 8 a second embedded diffusion layer 22" deeper than the first

embedded diffusion layer 21 (101). However, Watanabe teaches in Figure 9 that the second embedded diffusion layer 22" of Figure 8 extends through element 21 (201) and into element 41' and then into element 3 to a location that is just below element 52. Accordingly, Watanabe teaches in Figure 8 that the second embedded diffusion layer 22" is thicker than the first embedded diffusion layer 21 (101). Thus, from Figure 8, the Examiner cannot draw the conclusion that the peak position of an impurity concentration of a region formed between the silicon substrate and a based region of the second vertical transistor is deeper than that of a region formed between the silicon substrate and a base region of the first vertical transistor.

As stated in Watanabe at col. 9, lines 29-30, "FIG. 9 shows the distribution of impurity concentration along the line Y-Y' in FIG. 8." Accordingly, Figure 9 of Watanabe only illustrates impurity concentration as a function of distance from the datum surface (Y') of the substrate 1 for the second vertical type bipolar transistor 201. Figure 9 does not provide any relative distance (depth) relationships between features of the first vertical type bipolar transistor 101 and the second vertical type bipolar transistor 201. Accordingly, the teachings of Figure 9 cannot be used to teach the impurity concentration of element 21 (101).

Figure 4A and Figure 4B of Watanabe provide relative distance (depth) relationships between features of a first vertical type bipolar transistor and a second vertical type bipolar transistor. However, Figure 4A and Figure 4B are too small to draw any conclusions as to the relative distances between the peak position of an impurity concentration of the

first embedded diffusion layer and the peak position of an impurity concentration of the second embedded diffusion layer. Additionally, Figure 4B does not address the peak position of element 22" (as used by the Examiner to teach the second embedded diffusion layer).

Since Watanabe does not teach or even suggest that the peak position of element 21 (101) resides higher up with respect to the line Y-Y' than does the peak position of element 22", Watanabe does not teach the above limitation.

3. Claim 6

Claim 6 recites the limitation:

wherein the impurity concentration of the second embedded diffusion layer is approximately equal to or higher than the epitaxial impurity concentration at all distances from the datum surface of the substrate beyond the peak position of the impurity concentration of the second embedded diffusion layer and *the impurity concentration of the second embedded diffusion layer is $1x10^{13}$ to $1x10^{15}$.*

Neither Kumamaru nor Watanabe teach this limitation.

The Examiner states that this range is a matter of design choice.

Applicant asserts that the Examiner's conclusory statement about design choice is not "actual evidence" supporting a suggestion to combine. Moreover, the Examiner does not particularly identify any suggestion, teaching, or motivation to combine this design choice with any of the references. The Examiner has not presented any specific--or even inferential--findings concerning the identification of the relevant art, the level of ordinary skill in the art, the nature of the problem to be solved, or any other factual

findings that might serve to support a proper obviousness analysis. Moreover, since the Examiner has not presented any sources from which to choose the recited range as a choice, there is no basis for stating that such a choice is a design choice.

Here, the obviousness analysis in the Office Action is limited to conclusory statement that recited range would be an obvious design choice. The Examiner's reference-by-reference, limitation-by-limitation analysis fails to demonstrate how the Kumamaru or Watanabe references teach or suggest their combination with the "skills of an artisan, subject to routine experimentation and optimization" to yield the claimed invention.

Since there are no statements by the Examiner to show that there was a suggestion, teaching, or motivation to combine the prior art references cited against the pending claim, the Examiner's conclusion of obviousness, as a matter of law, cannot stand.

4. Conclusion

For the above reasons, Applicant respectfully requests that the Examiner withdraw the rejection to the claims.

B. CLAIM 17

The Examiner rejected claim 17 under 35 USC 103(a) as unpatentable over Kumamaru (U.S. 4,379,726) or Watanabe (U.S. 4,258,379) in view of inherent structures and Takemoto (U.S. 4,826,780).

Claim 17 is allowable by its dependency form claim 1.

For the above reasons, Applicant respectfully requests that the Examiner withdraw the rejection to the claim.

V. Examiner Response to Applicant's Arguments

The Examiner presents responses to Applicant's prior arguments.

VI. New claims 21-23

Claim 21 recites the limitation:

wherein the impurity concentration of the second embedded diffusion layer is approximately equal to or higher than the epitaxial impurity concentration at all distances from the datum surface of the substrate beyond the peak position of the impurity concentration of the second embedded diffusion layer.

a. Kumamaru

The Examiner presents Kumamaru element 5a as teaching the second embedded diffusion layer and Kumamaru element 11 as teaching the epitaxial layer.

Kumamaru element 5a (Figure 8) is formed by diffusing element 10 (Figure 7) into element 5. (Kumamaru col. 3, lines 28-30). The impurity concentration of Kumamaru element 10 (and arguably Kumamaru element 5a) is $7x10^{11}/cm^3$ to $1.2x10^{12}/cm^3$. Kumamaru col. 4, lines 19-20). The impurity concentration of Kumamaru element 11 is $1x10^{14}/cm^3$ to $5x10^{14}/cm^3$. (Kumamaru col. 4, lines 21-24) Since the impurity concentration of Kumamaru element 5a ($7x10^{11}/cm^3$ to $1.2x10^{12}/cm^3$) is less than the impurity concentration of Kumamaru element 11 ($1x10^{14}/cm^3$ to $5x10^{14}/cm^3$), Kumamaru does not teach the above limitation.

Alternatively, Kumamaru's does not teach or suggest any impurity concentration of Kumamaru element 10. Kumamaru element 5a (Figure 8) is formed by diffusing element 10 (Figure 7) into element 5. The impurity concentration of Kumamaru element 10 is $7x10^{11}/cm^3$ to $1.2x10^{12}/cm^3$. The impurity concentration of Kumamaru element 5 is $1x10^{14}/cm^3$ to $5x10^{14}/cm^3$.

(Kumamaru col. 4, lines 14-17) Certainly, the impurity concentration of Kumamaru element 5a is less than $1x10^{14}/cm^3$ to $5x10^{14}/cm^3$ due to the diffusion of element 10 into element 5. Thus, Kumamaru arguably teaches that the impurity concentration of Kumamaru element 5a (less than $1x10^{14}/cm^3$ to $5x10^{14}/cm^3$) is less than the impurity concentration of Kumamaru element 11 ($1x10^{14}/cm^3$ to $5x10^{14}/cm^3$).

Whatever Kumamaru teaches regarding the impurity concentration of Kumamaru element 5a, it is insufficient to draw the conclusion that Kumamaru teaches the above limitation.

b. Watanabe

The Examiner presents Watanabe element 22" (Figure 8) as teaching the second embedded diffusion layer and Watanabe element 3 as teaching the epitaxial layer.

As seen in Figure 9 of Watanabe, the impurity concentration of the Watanabe second embedded diffusion layer 22" is less than the epitaxial impurity concentration (element 3) at a distance from the datum surface of Watanabe substrate 1 along line Y-Y' in Figure 8 beyond the peak position (Figure 9) of the impurity concentration of the Watanabe second embedded diffusion layer 22". Accordingly, Watanabe does not teach the above limitation.

Claim 22 is not taught by the cited art. Claim 22 is supported in Figure 6 and Figure 7 where peak position 700 of an impurity concentration of the second embedded diffusion layer resides at a distance from the datum surface of the substrate that is approximately equal to a location of the bottom of the first embedded diffusion layer 131 from the datum surface of the substrate, wherein the bottom of the

first embedded diffusion layer 131 is illustrated by the broken line to the right of element 131 in Figure 6.

Claim 23 is allowable by its dependency on claim 1.

VII. Conclusion

In view of the foregoing, it is believed that the claims now pending are in condition for allowance. Such action is earnestly solicited at the earliest possible date. If the Examiner believes that a conference would be of value in expediting the prosecution of this application, the Examiner is invited to telephone the undersigned counsel to arrange for such a conference.

Respectfully submitted,
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Rose M. Garza Date: February 6, 2001